



NORTHROP GRUMMAN

DEFINING THE FUTURE

Mission Systems

Using Six Sigma to Improve Systems Engineering

**NDIA Systems Engineering
Supportability & Interoperability
Conference**

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What is Six Sigma?

- **Six Sigma is a management philosophy based on meeting business objectives by striving for perfection**
 - A disciplined, data-driven methodology for decision making and process improvement
- **Six Sigma consists of several integrated methods:**
 - Process Management
 - Voice of the Customer
 - Change Management
 - Tools for Measuring Variation and Change
 - Business Metrics
- **The focus is on understanding and reducing variation**



DMAIC Steps

DEFINE

Set project goals and objectives

MEASURE

Narrow range of potential causes and establish baseline capability level

ANALYZE

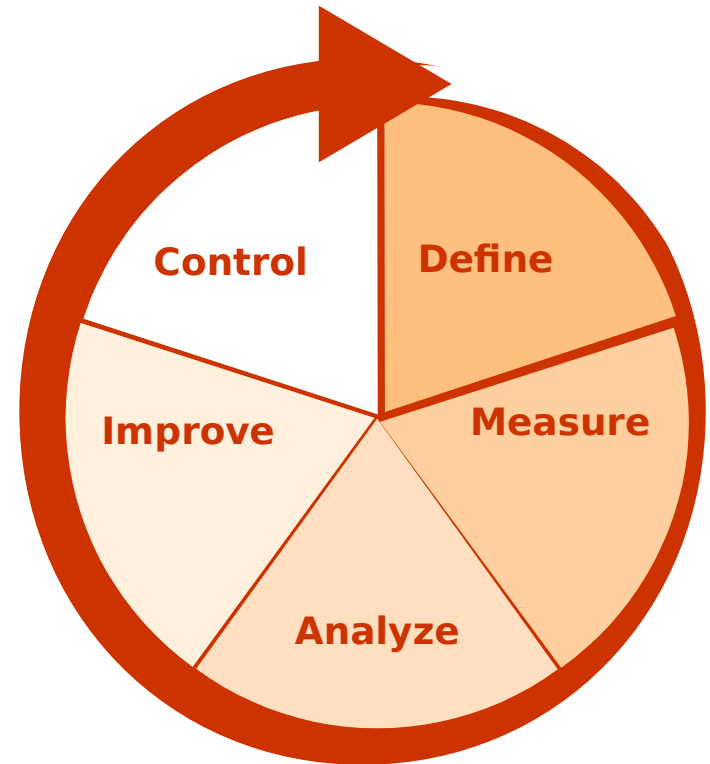
Evaluate data/information for trends, patterns, causal relationships and “root causes”

IMPROVE

Develop, implement and evaluate solutions targeted at identified root causes

CONTROL

Make sure problem stays fixed and new methods can be further improved over time





Applying Six Sigma to Systems Engineering

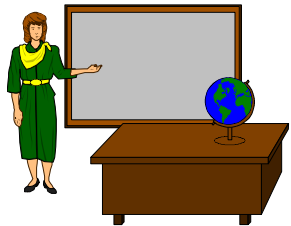
- **Software and system processes are fuzzy**
 - Production of software or systems engineering "parts" is less predictable than manufacturing of physical parts
 - Greater variation in human cognitive processes can prevent rigorous application of the Six Sigma methodology
 - Process variation can never be eliminated and may not even be reduced below a moderate level
- **Results often cannot be measured in clear \$ savings returned to organization**
 - Benefits are reduced risk, increased customer satisfaction, more competitive bids, ...

Our Six Sigma Approach



Linked with Business Planning and Oversight

- Business planning
- Project selection



Enabled by Infrastructure

- Training
- Tools
- Awareness
- Database

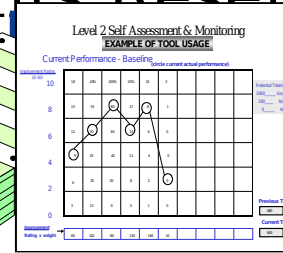
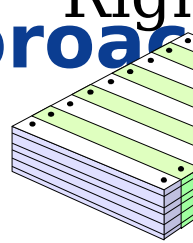


Minitab.Ink

StartIt! - a NGMS product

Quantitatively Driven

- Six Sigma improvements are quantified



Quantitative Process Capability Measurement and Assessment Report

Self Assessment & Monitoring
EXAMPLE OF TOOL USAGE

Category	Subcategory	Score	Weight	Weighted Score
Process Capability	Process Capability Index	4	1	4
	Process Capability Index	4	1	4
	Process Capability Index	4	1	4
	Process Capability Index	4	1	4
Quality Goals	Quality Goals	4	1	4
	Quality Goals	4	1	4
	Quality Goals	4	1	4
	Quality Goals	4	1	4

Score=100

Integrated with Quality Program

- Integrated Training, Awareness, & Policies
- Integrated CMMI & Six Sigma projects
- Integrated tracking and reporting via DB, PRA, etc.

Tied to Employee Performance

- Goals, awards
- Job and career paths

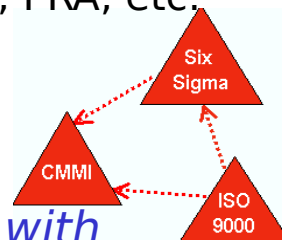


Identification Information:

Name:	
Nickname:	
Job Title:	
Unit:	
Location:	
Six Sigma Status:	
Employee ID:	

Engaged with External Customers

- Visibility
- Participation



Six Sigma Implementation

- **Starting implementing Six Sigma in 2001**
- **Trained over 3000 Green Belts (80 hours), and over 200 Black Belts (160 hours)**
- **Completed several hundred projects covering all functional areas**
 - Customer involvement and award fee citations
- **About half of the projects are improving an engineering process**



Level	Focus	Process Areas
5 Optimizing	<i>Continuous process improvement</i>	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	<i>Quantitative management</i>	Quantitative Project Management Organizational Process Performance
3 Defined	<i>Process standardization</i>	Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution Requirements Development Technical Solution Product Integration Verification Validation
2 Managed	<i>Basic project management</i>	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed		

Capability Maturity Model Integrated

Level 5
Focus is on preventing defects and innovation (addressing common causes of variation)

Level 4
Focus is on understanding and managing special causes of variation, at both the project and organizational

levels

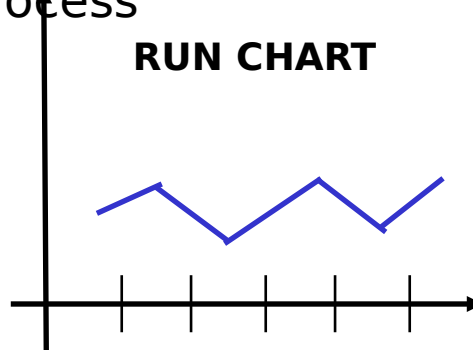
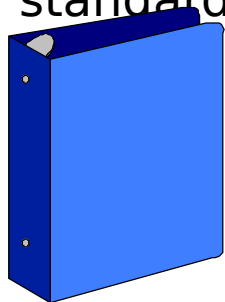
Maturity Level 4

Understanding and managing special causes of variation



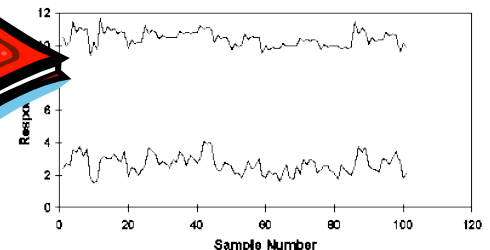
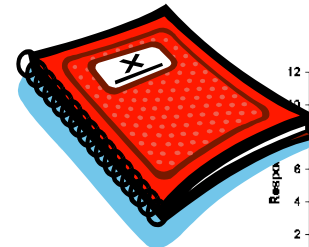
Organization

- Establishes organizational goals
- Establishes standard process
- Characterizes process performance and quality of the standard process



Project

- Establishes project goals
- Tailors standard organizational process to create project's defined process
- Selects critical subprocesses to quantitatively manage

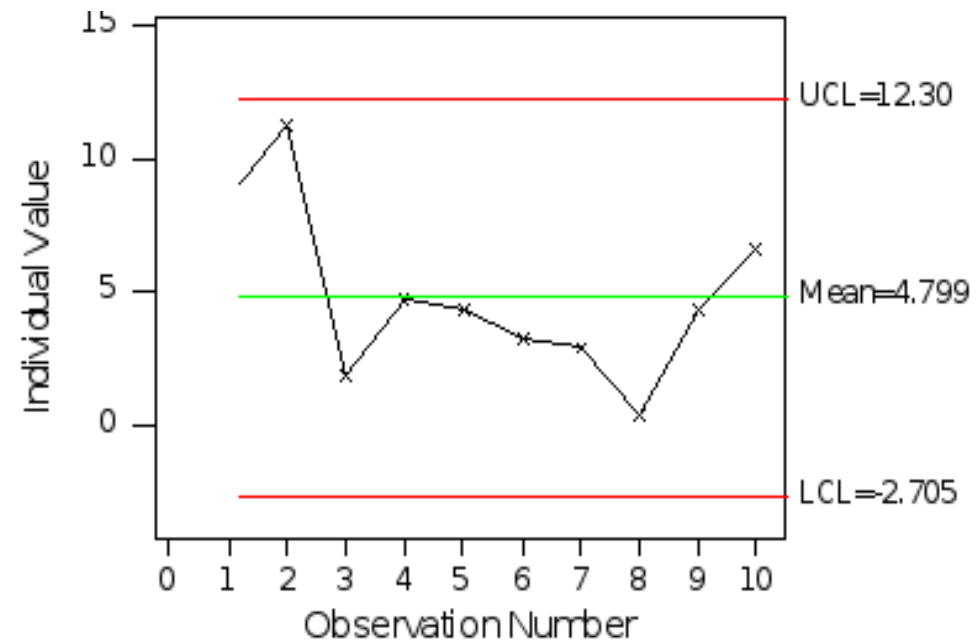




Quantitative Management Example (not real data)

Peer Reviews - Understanding the Process

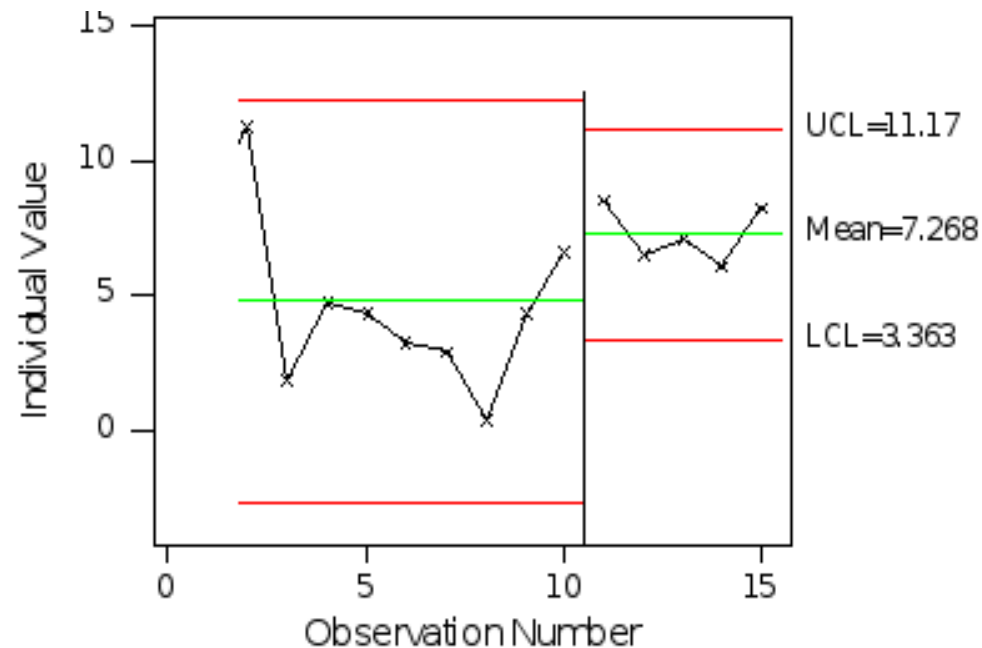
- **How many errors does the team typically find in reviewing an interface specification?**
- **Useful in evaluating future reviews**
 - Was the review effective?
 - Was the process different?
 - Is the product different?





Quantitative Management Example (not real data) **Peer Reviews - Improving the Process**

- **Reduce the variation**
 - Train people on the process
 - Create procedures/checklists
 - Strengthen process audits
- **Increase the effectiveness (increase the mean)**
 - Train people
 - Create checklists
 - Reduce waste and re-work
 - Replicate best practices from other projects



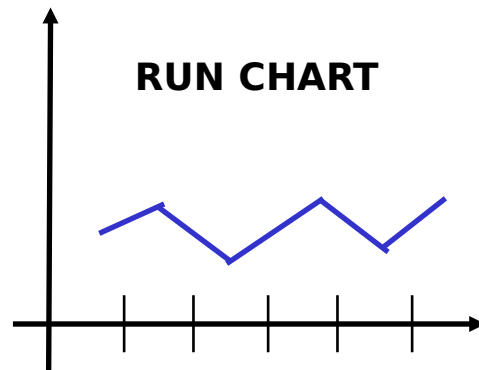
Maturity Level 5

Preventing defects and innovation (addressing common causes of)

Organization



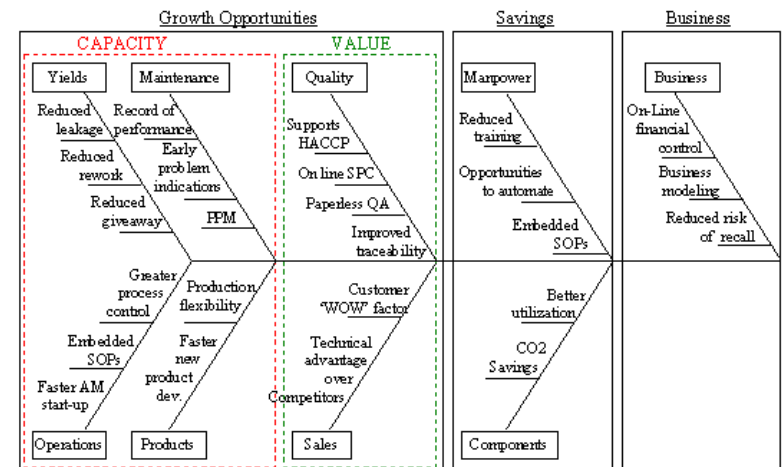
- Identifies incremental and innovative improvements
- Pilots improvements
- Deploys and measures (quantitatively) the results



Project



- Identifies causes of defects and other problems
- Takes actions to prevent them from occurring in the future



Results

- **Organizational-wide adoption and training has resulted in a workforce that understands variation**
 - Common language
 - Common toolset
 - Common focus on reducing variation
- **Results have been seen in our rapid achievement of CMMI Levels 4 and 5**
 - Transition from Level 3 to 5 typically takes about 18 months
 - **Our organizations have been transitioning in 9 months!**

